

3-28-16

**US EPA
Source Test Report**

**XTO Energy, Inc.
Little Canyon Compressor Station Facility
Utah
March 9, 2016
Permit: N/A
Engine: Caterpillar G3516LE
SN: 4EK04246
Unit ID: LCU #2**

Prepared By:

Oasis Emission Consultants, Inc.
2730 Commercial Way
Rock Springs, WY 82901





March 28, 2016

Mr. Craig Allison
XTO Energy, Inc.
810 Houston Street
Fort Worth, Texas 76102

Dear Mr. Allison:

Re: Engine Emission Testing For XTO Energy, Inc., Little Canyon Compressor Station Facility, Unit LCU #2, Permit N/A.

Oasis Emission Consultants, Inc. was requested to perform an annual engine emission test on a Caterpillar G3516LE lean burn engine (Permit N/A) located in Utah.

Emission Levels

The average recorded levels are shown in the attached report and summarized below.

Emission Unit	Avg NOx	Avg CO
g/bhp-hr	1.86	0.06
lbs/hr	4.83	0.14

Formaldehyde Levels

Test Run	HCOH ppmvd	HCOH ppmvd @ 15% O2	HCOH ppmvd @ 15% O2 Limit
1	7.91	3.65	14
2	7.65	3.58	14
3	7.54	3.53	14
AVG	7.70	3.59	14

Catalyst Parameters

Test Run	Inlet Temp (deg F)	DP (in H ₂ O)
1	851	2.9
2	856	2.9
3	852	2.9
AVG	853	2.9

Engine Load

Test Run	BHP	% Load
1	1165.3	87.0
2	1186.7	88.6
3	1180.6	88.1
AVG	1177.5	87.9

Testing Protocol

The attached report was generated using an extractive FTIR system using methodologies as required by EPA 40 CFR 60(A) Methods 1 and 19 & EPA 40 CFR 63(A), Method 320 and/or ASTM D 6348-03, as well as ASTM D6522-00(2005).

Quality Assurance

Oasis has performed a full cursory review of the raw data and calculated results in this report. Any errors we have encountered have been listed in the body of this report. After performing the review, we are confident that this engine has met all requirements.

If you have any questions or require further information, please contact the undersigned at (307) 382-3297.

Yours truly,
Oasis Emission Consultants, Inc.



Cember Crawley
Environmental Scientist



Charles A. Chapman
Senior Environmental Scientist



Christopher N. Knott, P.Eng.
Director, Engineering & Operations

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SOURCE EMISSION TEST REPORT

PERMIT N/A

Test Performed By: **Oasis Emission Consultants, Inc.**

Facility Name: **Little Canyon Compressor Station
Facility Unit LCU #2**

Emission Source: **Caterpillar G3516LE**

Date of Test: **March 9, 2016**

Date of Report: **March 28, 2016**

1.1 Introduction

The purpose of this source test was to demonstrate that source emissions from a Caterpillar G3516LE engine were below maximum allowable levels specified by EPA 40 CFR 63, Subpart ZZZZ.

The Caterpillar G3516LE engine is a lean burn engine that employs an Oxidation Catalytic Converter to regulate emission levels.

Three test runs were performed on March 9, 2016 to analyze NOx, CO & HCOH emission levels. Test runs were performed according to methodologies outlined by EPA 40 CFR 60(A) Methods 1 and 19, and in the ASTM D 6348-03 & EPA 40 CFR 63(A), Method 320 Protocol. Effluent exhaust was sampled from the engine through an extractive heated stainless steel sample line interconnected to an MKS 2030 FTIR analyzer.

Each of the three runs consisted of sixty (60) readings taken at one (1) minute intervals.

Test runs were observed by the following individuals:

- Kevin Watkins, OEC
- Derrick, XTO

2.1 Equipment Utilization

The following equipment was used during the tests performed at this facility in conjunction with procedures outlined by EPA 40 CFR 60(A) Methods 1 and 19 & EPA 40 CFR 63(A), Method 320 and/or ASTM D 6348-03, as well as ASTM D6522-00(2005).

- (1) MKS MultiGas 2030 FTIR Continuous Gas Analyzer
- (1) Laptop Computer for the FTIR Analyzer using MKS MG2000 Software
- (1) 75ft or 100ft Heated Teflon Line w/ Heated Sample Probe & Spike Bypass Line
- (1) Portable O₂/CO₂ Analyzer
- (6) EPA Protocol G1 Calibration Gas (NO_x, CO, C₃H₈, CH₃CHO, C₂H₄ & NO₂)

The MKS Multigas 2030 FTIR Analyzer was used to measure NO_x & CO on a dry basis. Formaldehyde levels were measured on a wet basis and were corrected to produce levels on a dry basis. A pre Direct and System calibration measurement was made on compounds of NO_x, CO, CH₃CHO, C₃H₈ & C₂H₄. In addition, a post Direct calibration was made on compounds of NO_x, CO, CH₃CHO, C₃H₈ & C₂H₄. Compounds of CO₂, CO, NO, CH₃CHO & C₃H₈ were measured for the quality assurance spiking requirements of EPA 40 CFR 63(A), Method 320 & ASTM D 6348-03.

When a gas sample is introduced in the gas cell, the infrared beam is partially absorbed by the gas species present. The spectral frequencies absorbed and their intensity are due to the atoms associated with the chemical bond and the strength of that bond. The absorption spectrum is unique for each infrared-active gas. The MKS Analyzer measures the absorption spectrum, and its analysis algorithm measures the concentration of each gas using pre-loaded calibrations. The MG2000 software allows for the continuous measurement, display and recording of the sample stream.

The MKS Multigas 2030 FTIR Analyzer operated with a spectral resolution of 0.5 cm⁻¹ and a scan time of 30 seconds. The FTIR spectrometer utilizes a multi-pass gas cell with a 5.11 meter effective pathlength.

3.1 Discussion of NOx, CO & HCOH Test Results

Please refer to Appendix A for the raw NOx, CO & HCOH test results. Please refer to Appendix B for a listing of all raw data, calibration error response and calculations performed per ASTM & EPA requirements. Overall the average emission levels complied with Subpart ZZZZ requirements. Testing for NOx, CO & HCOH were run concurrently with one another.

3.1.1 Source Test 1: Caterpillar G3516LE, NOx, CO & HCOH

The first test was performed from 9:15 to 10:14 for NOx, CO & HCOH.

Based on the approximated load of **1165.3 bhp**, the average NOx and CO levels were found to be **1.86 g/bhp-hr and 0.05 g/bhp-hr** respectively. The HCOH tested at **3.65 ppmvd @ 15% O₂** during this test period.

Test Run	NOx (ppmvd)	NOx (g/bhp-hr)	CO (ppmvd)	CO (g/bhp-hr)	HCOH (ppmvd)	HCOH (ppmvd @ 15% O ₂)
1	258.06	1.86	12.42	0.05	7.91	3.65

3.1.2 Source Test 2: Caterpillar G3516LE, NOx, CO & HCOH

The second test was performed from 10:19 to 11:18 for NOx, CO & HCOH.

Based on the approximated load of **1186.7 bhp**, the average NOx and CO levels were found to be **1.85 g/bhp-hr and 0.06 g/bhp-hr** respectively. The HCOH tested at **3.58 ppmvd @ 15% O₂** during this test period.

Test Run	NOx (ppmvd)	NOx (g/bhp-hr)	CO (ppmvd)	CO (g/bhp-hr)	HCOH (ppmvd)	HCOH (ppmvd @ 15% O ₂)
2	252.04	1.85	12.41	0.06	7.65	3.58

3.1.3 Source Test 3: Caterpillar G3516LE, NOx, CO & HCOH

The third test was performed from 11:25 to 12:24 for NOx, CO & HCOH.

Based on the approximated load of **1180.6 bhp**, the average NOx and CO levels were found to be **1.87 g/bhp-hr and 0.06 g/bhp-hr** respectively. The HCOH tested at **3.53 ppmvd @ 15% O₂** during this test period.

Test Run	NOx (ppmvd)	NOx (g/bhp-hr)	CO (ppmvd)	CO (g/bhp-hr)	HCOH (ppmvd)	HCOH (ppmvd @ 15% O ₂)
3	254.77	1.87	12.45	0.06	7.54	3.53

4.1 Stack Sampling Location

The sampling port for moisture, flow, NOx, CO and HCOH measurements was a minimum of 2.0 pipe diameters from the nearest upstream flow disturbance and 0.5 pipe diameters from the nearest downstream disturbance.

4.2 Stack Sampling Methods & Procedures

Testing followed EPA 40 CFR 60(A) Methods 1 and 19 & EPA 40 CFR 63(A), Method 320 and/or ASTM D 6348-03, as well as ASTM D6522-00(2005) methodologies per our standard protocol, with no exceptions.

5.1 Quality Assurance

CTS procedures were followed according to ASTM requirements for both pre and post testing. Similarly, QA spiking procedures were followed. Analysis of the CO₂ exhaust effluent was used to determine the dilution factor. Steady levels of the CO₂ were observed and a sufficient duration of time was allowed to elapse for a representative average.

The calibration gas was spiked into the effluent stream using a bypass line at approximately 10% of the sampling rate. The dilution factor was obtained from observation of the stack CO₂ behavior using the following equation:

$$DF = \frac{CO_2^{AVG} - CO_2^{SPIKE}}{CO_2^{AVG}}$$

Where: CO₂_{AVG} = The average undiluted CO₂ stack gas concentration of spike measurements
CO₂_{SPIKE} = The average diluted CO₂ stack gas concentration when spiked

The sample recovery was then obtained from the following equation:

$$\frac{\% REC = (Spike_{MEAS} - Stack_{MEAS}) * (1 - DF)}{CS * DF}$$

Where: Spike_{MEAS} = The average diluted stack gas concentration when spiked
Stack_{MEAS} = The average undiluted stack gas concentration
DF = Dilution factor
CS = Certified concentration of calibration standards

The Sample Recovery average level for CO, NO, C₃H₈ & CH₃CHO was found to be 100.0%, 98.8%, 97.2% & 98.3% respectively, which was within the allowable tolerance of Method 320 (70% to 130%). A summary of all spiking procedures/results can be found in Appendix B.

APPENDIX A

XTO Energy, Inc.
Little Canyon Compressor Station LCU #2

Run 1

Record	FTIR Measurements				Date	Time
	NOx Dry (ppm)	CO Dry (ppm)	Formaldehyde 191C Wet (ppm)	H2O% (High) 191C		
1	259.720357	12.382662	7.343276	12.349278	3/9/2016	9:15:22
2	260.286204	12.191025	6.841596	11.898405	3/9/2016	9:16:22
3	257.83479	12.240207	6.923154	12.090505	3/9/2016	9:17:22
4	258.754079	12.126782	6.886994	12.163511	3/9/2016	9:18:22
5	251.085329	12.289074	6.946738	12.14897	3/9/2016	9:19:22
6	261.973242	12.122869	6.813114	12.001864	3/9/2016	9:20:21
7	258.133978	12.028209	6.858487	11.693846	3/9/2016	9:21:21
8	262.947301	12.239643	6.714945	11.741997	3/9/2016	9:22:21
9	259.67348	12.188329	6.61351	11.503322	3/9/2016	9:23:21
10	258.331269	12.240742	6.542922	11.171048	3/9/2016	9:24:21
11	258.00421	12.146942	6.591501	11.456929	3/9/2016	9:25:21
12	255.517654	12.322855	6.712767	11.771852	3/9/2016	9:26:21
13	258.194084	12.153708	6.678266	11.800848	3/9/2016	9:27:21
14	256.637811	12.164944	6.869267	12.064686	3/9/2016	9:28:21
15	261.537364	12.165188	6.86227	11.846048	3/9/2016	9:29:20
16	259.432623	12.153602	6.828275	11.29003	3/9/2016	9:30:20
17	256.269075	12.247602	6.949248	11.598325	3/9/2016	9:31:20
18	256.678959	12.362164	6.745387	11.791563	3/9/2016	9:32:20
19	255.636184	12.348483	6.844555	11.952143	3/9/2016	9:33:20
20	257.212862	12.434381	6.882305	12.027512	3/9/2016	9:34:20
21	257.600921	12.55887	7.186325	12.187665	3/9/2016	9:35:20
22	255.540091	12.335347	7.057052	12.168483	3/9/2016	9:36:20
23	254.430696	12.327371	6.815868	12.14861	3/9/2016	9:37:19
24	258.17287	12.348824	6.991772	12.429694	3/9/2016	9:38:19
25	259.645632	12.270363	7.079126	12.700159	3/9/2016	9:39:19
26	258.948066	12.117506	7.112243	12.711358	3/9/2016	9:40:19
27	259.397529	12.287379	7.073082	12.637978	3/9/2016	9:41:19
28	257.580978	12.259058	7.136448	12.596004	3/9/2016	9:42:19
29	255.792372	12.255655	7.166307	12.539309	3/9/2016	9:43:19
30	256.040036	12.43165	7.139414	12.346171	3/9/2016	9:44:19
31	256.483624	12.422867	6.969658	12.307692	3/9/2016	9:45:19
32	258.821588	12.417314	7.116813	12.464619	3/9/2016	9:46:18
33	255.697781	12.574308	7.167243	12.628725	3/9/2016	9:47:19
34	257.778158	12.507476	7.085265	12.639205	3/9/2016	9:48:18
35	258.48944	12.501617	7.148393	12.742977	3/9/2016	9:49:18
36	256.686717	12.434493	7.116605	12.593094	3/9/2016	9:50:18
37	257.050926	12.455134	6.936633	12.374437	3/9/2016	9:51:18
38	255.551579	12.528246	6.975894	12.368363	3/9/2016	9:52:18
39	258.60477	12.45442	6.933666	12.306706	3/9/2016	9:53:18
40	260.867442	12.579646	6.860118	12.116656	3/9/2016	9:54:18
41	259.261793	12.461965	6.840798	12.147046	3/9/2016	9:55:17
42	258.208542	12.497303	6.99511	12.692443	3/9/2016	9:56:17
43	260.050811	12.586706	6.999656	12.426567	3/9/2016	9:57:17
44	257.491964	12.534056	6.970262	12.534777	3/9/2016	9:58:17
45	256.795111	12.53842	7.128577	12.897149	3/9/2016	9:59:17
46	259.627686	12.529405	7.03203	12.645543	3/9/2016	10:00:17
47	261.825695	12.600234	7.119718	12.647314	3/9/2016	10:01:17
48	257.093951	12.587297	7.343983	12.834925	3/9/2016	10:02:17
49	257.595514	12.667128	7.647676	12.7853	3/9/2016	10:03:17
50	258.670075	12.684444	7.119571	12.631629	3/9/2016	10:04:16
51	255.021427	12.688793	7.036295	12.537392	3/9/2016	10:05:16
52	257.172906	12.773098	6.923365	12.295159	3/9/2016	10:06:16
53	259.878522	12.759644	6.84873	12.079054	3/9/2016	10:07:16
54	258.364353	12.601724	6.842479	11.982533	3/9/2016	10:08:16
55	257.145259	12.705983	6.879441	12.174027	3/9/2016	10:09:16
56	257.471776	12.674312	6.85051	12.134572	3/9/2016	10:10:16
57	259.372472	12.57008	6.77748	11.922266	3/9/2016	10:11:15
58	256.92517	12.775633	6.721854	11.626408	3/9/2016	10:12:15
59	261.377697	12.699604	6.636074	11.553021	3/9/2016	10:13:15
60	261.440299	12.75991	6.671855	11.619422	3/9/2016	10:14:15
AVG	258.06	12.42	6.95	12.19		
ppm@15% O2	118.95	5.73				

Calculated Emission Levels

NOx (g/bhp-hr)	NOx (lbs/hr)	CO (g/bhp-hr)	CO (lbs/hr)	HCOH Dry (ppm)	HCOH@15% O2 (ppm)	HCOH (g/bhp-hr)	HCOH (lbs/hr)
1.86	4.78	0.05	0.14	7.91	3.65	0.037	0.096

XTO Energy, Inc.
Little Canyon Compressor Station LCU #2

Record	FTIR Measurements				Date	Time
	NOx Dry (ppm)	CO Dry (ppm)	Formaldehyde 191C Wet (ppm)	H2O% (High) 191C		
1	256.890995	12.761031	6.318722	8.883844	3/9/2016	10:19:10
2	258.818068	12.797039	6.404571	9.222504	3/9/2016	10:20:10
3	259.92792	12.773764	6.22694	9.768076	3/9/2016	10:21:10
4	258.579371	12.608175	7.280947	12.51294	3/9/2016	10:22:10
5	256.60009	12.689682	7.096585	10.632551	3/9/2016	10:23:10
6	256.968937	12.828137	6.257409	9.586982	3/9/2016	10:24:09
7	255.083734	12.784492	6.277527	9.871155	3/9/2016	10:25:09
8	255.733436	12.621844	6.869875	11.673387	3/9/2016	10:26:09
9	255.81038	12.764561	6.470686	10.20115	3/9/2016	10:27:09
10	257.097263	12.773677	6.30741	10.059646	3/9/2016	10:28:09
11	257.603878	12.789578	6.253963	10.43279	3/9/2016	10:29:09
12	252.291563	12.716955	6.532137	11.004008	3/9/2016	10:30:09
13	256.0661	12.706886	6.563617	10.441343	3/9/2016	10:31:08
14	255.756274	12.70913	6.629729	11.089903	3/9/2016	10:32:08
15	255.872386	12.718498	6.580185	11.151574	3/9/2016	10:33:08
16	256.027217	12.702276	6.629774	11.77942	3/9/2016	10:34:08
17	257.29012	12.614642	6.680506	11.741152	3/9/2016	10:35:08
18	250.717213	12.688387	6.925948	11.620742	3/9/2016	10:36:08
19	255.189164	12.704499	7.022069	12.220971	3/9/2016	10:37:08
20	255.073438	12.628454	7.194033	12.520955	3/9/2016	10:38:08
21	153.155549	7.99608	7.330729	12.096288	3/9/2016	10:39:08
22	146.375585	7.561486	5.462593	12.810176	3/9/2016	10:40:08
23	257.505372	12.627513	6.491317	11.372864	3/9/2016	10:41:07
24	254.440852	12.527548	6.32848	11.085752	3/9/2016	10:42:07
25	257.256342	12.519774	6.257166	10.723291	3/9/2016	10:43:07
26	254.103196	12.602376	6.279887	10.469067	3/9/2016	10:44:07
27	257.876311	12.651821	6.571564	11.084623	3/9/2016	10:45:07
28	253.742032	12.633233	6.559989	11.138311	3/9/2016	10:46:07
29	253.083263	12.617826	6.654467	11.746927	3/9/2016	10:47:07
30	255.847178	12.67474	6.872395	12.125383	3/9/2016	10:48:07
31	256.634497	12.620092	6.811358	11.850819	3/9/2016	10:49:06
32	258.817297	12.622234	6.751694	10.872912	3/9/2016	10:50:06
33	262.044844	12.609577	6.71484	11.189474	3/9/2016	10:51:06
34	259.061325	12.627652	7.004939	11.58412	3/9/2016	10:52:06
35	257.910704	12.596603	7.009846	12.148985	3/9/2016	10:53:06
36	256.336085	12.669304	6.661032	11.556175	3/9/2016	10:54:06
37	256.469438	12.633644	6.701104	11.473969	3/9/2016	10:55:06
38	255.516767	12.665978	6.847701	11.351122	3/9/2016	10:56:06
39	256.444244	12.669075	7.071937	11.732233	3/9/2016	10:57:06
40	256.304934	12.467294	7.108305	12.596949	3/9/2016	10:58:05
41	253.474418	12.45363	7.247946	12.851033	3/9/2016	10:59:05
42	254.485989	12.554684	7.3466	13.137835	3/9/2016	11:00:05
43	249.173494	12.436676	7.122139	12.73031	3/9/2016	11:01:05
44	251.75804	12.533427	7.272082	13.116957	3/9/2016	11:02:05
45	251.447497	12.312722	7.356062	13.083894	3/9/2016	11:03:04
46	256.688662	12.466384	7.238858	12.892249	3/9/2016	11:04:04
47	254.573448	12.484911	7.067416	12.641468	3/9/2016	11:05:04
48	255.988706	12.41806	7.079271	12.673578	3/9/2016	11:06:04
49	251.380397	12.409252	7.045901	12.471561	3/9/2016	11:07:04
50	254.381309	12.491205	6.918592	12.280327	3/9/2016	11:08:04
51	251.586688	12.502154	6.870028	12.065768	3/9/2016	11:09:04
52	255.522852	12.439632	6.750289	11.908131	3/9/2016	11:10:03
53	254.39501	12.495409	6.766366	11.997547	3/9/2016	11:11:04
54	254.34616	12.269191	6.801213	12.039883	3/9/2016	11:12:03
55	255.807864	12.313495	6.744442	12.078521	3/9/2016	11:13:03
56	254.003073	12.193184	6.843653	12.182495	3/9/2016	11:14:03
57	255.205516	12.232284	6.808715	12.351577	3/9/2016	11:15:03
58	257.377996	12.22907	6.735804	12.216918	3/9/2016	11:16:03
59	254.975803	12.304325	6.821949	12.353862	3/9/2016	11:17:03
60	253.242115	12.365085	6.814671	12.185792	3/9/2016	11:18:02
AVG	252.04	12.41	6.76	11.61		
ppm@15% O2	118.02	5.81				

Calculated Emission Levels							
NOx (g/bhp-hr)	NOx (lbs/hr)	CO (g/bhp-hr)	CO (lbs/hr)	HCOH Dry (ppm)	HCOH@15% O2 (ppm)	HCOH (g/bhp-hr)	HCOH (lbs/hr)
1.85	4.83	0.06	0.15	7.65	3.58	0.037	0.096

XTO Energy, Inc.
Little Canyon Compressor Station LCU #2

Run 3

Record	FTIR Measurements				Date	Time
	NOx Dry (ppm)	CO Dry (ppm)	Formaldehyde 191C Wet (ppm)	H2O% (High) 191C		
1	254.437979	12.241924	7.189413	12.648328	3/9/2016	11:25:54
2	254.805106	12.268721	6.878986	11.988907	3/9/2016	11:26:54
3	253.403457	12.354744	6.542262	11.044208	3/9/2016	11:27:54
4	255.642174	12.323036	6.368693	10.678369	3/9/2016	11:28:53
5	253.097911	12.266137	6.388971	11.221606	3/9/2016	11:29:53
6	252.00661	12.288593	6.459218	11.133684	3/9/2016	11:30:53
7	252.047531	12.237935	6.510135	11.589861	3/9/2016	11:31:53
8	258.352306	12.26566	6.494077	11.791454	3/9/2016	11:32:53
9	256.586984	12.266471	6.471328	10.996339	3/9/2016	11:33:53
10	255.672188	12.238836	6.315624	10.868911	3/9/2016	11:34:53
11	258.022749	12.388859	6.394295	11.326842	3/9/2016	11:35:53
12	255.082482	12.338258	6.474124	11.347838	3/9/2016	11:36:52
13	253.967018	12.355604	6.47125	11.313293	3/9/2016	11:37:52
14	254.961655	12.282069	6.622291	11.298902	3/9/2016	11:38:52
15	256.579398	12.324285	6.375385	11.589095	3/9/2016	11:39:52
16	255.758209	12.192645	7.061865	13.48149	3/9/2016	11:40:52
17	257.128928	12.301679	7.215875	13.260971	3/9/2016	11:41:52
18	257.544953	12.36682	7.051659	12.447539	3/9/2016	11:42:52
19	257.914843	12.451066	6.827493	11.128423	3/9/2016	11:43:52
20	254.5265	12.470994	6.42757	10.652659	3/9/2016	11:44:51
21	252.294049	12.411208	6.436827	11.046494	3/9/2016	11:45:51
22	252.501571	12.448663	6.498807	11.55639	3/9/2016	11:46:51
23	254.913815	12.393291	6.663085	12.195954	3/9/2016	11:47:51
24	257.932364	12.410152	6.799752	12.327734	3/9/2016	11:48:51
25	252.68607	12.467147	6.731111	11.620155	3/9/2016	11:49:51
26	253.248593	12.387117	6.60725	11.475837	3/9/2016	11:50:51
27	251.119136	12.449231	6.717998	11.778201	3/9/2016	11:51:51
28	251.870622	12.438055	6.667929	11.469819	3/9/2016	11:52:51
29	251.969817	12.325611	6.72344	11.744497	3/9/2016	11:53:51
30	255.42075	12.271662	6.897705	12.241281	3/9/2016	11:54:50
31	253.359158	12.397625	6.980731	12.431186	3/9/2016	11:55:50
32	257.298402	12.407214	6.777402	11.393608	3/9/2016	11:56:50
33	254.609475	12.439127	6.804429	10.82154	3/9/2016	11:57:50
34	255.728519	12.381592	7.079523	11.632861	3/9/2016	11:58:50
35	257.725201	12.472224	6.660541	11.877271	3/9/2016	11:59:50
36	255.217866	12.459874	6.715116	11.855114	3/9/2016	12:00:50
37	256.296995	12.536872	6.577437	11.312836	3/9/2016	12:01:49
38	252.478987	12.428718	6.605102	11.92759	3/9/2016	12:02:49
39	252.959527	12.41159	6.692251	11.908875	3/9/2016	12:03:49
40	252.12546	12.450158	6.615467	11.313462	3/9/2016	12:04:49
41	253.76107	12.540986	6.450624	10.851963	3/9/2016	12:05:49
42	253.600979	12.638544	6.491524	10.571233	3/9/2016	12:06:49
43	253.632118	12.711284	6.487191	10.471692	3/9/2016	12:07:49
44	256.232212	12.590593	6.842885	11.813565	3/9/2016	12:08:49
45	254.554799	12.497681	6.768385	11.674771	3/9/2016	12:09:49
46	252.730627	12.63144	6.842356	11.830649	3/9/2016	12:10:48
47	256.159432	12.690727	6.872107	11.198892	3/9/2016	12:11:48
48	255.014487	12.799766	6.851998	10.638686	3/9/2016	12:12:48
49	254.832978	12.702143	6.327165	10.262802	3/9/2016	12:13:48
50	256.924832	12.694647	6.071032	9.365361	3/9/2016	12:14:48
51	253.362506	12.615689	6.424517	10.271785	3/9/2016	12:15:48
52	253.900873	12.588064	6.901982	11.896803	3/9/2016	12:16:48
53	256.345806	12.524119	7.12929	12.882408	3/9/2016	12:17:48
54	254.840114	12.450784	7.179641	13.052463	3/9/2016	12:18:47
55	254.634486	12.44227	7.251337	12.450188	3/9/2016	12:19:47
56	254.754008	12.592263	6.817271	11.109624	3/9/2016	12:20:47
57	256.432787	12.573824	6.457319	10.155643	3/9/2016	12:21:47
58	252.845108	12.588433	6.345254	10.542264	3/9/2016	12:22:47
59	256.91963	12.679134	6.483462	11.083851	3/9/2016	12:23:47
60	255.508559	12.548299	6.577544	11.27855	3/9/2016	12:24:47
AVG	254.77	12.45	6.67	11.49		
ppm@15% O2	119.30	5.83				

Calculated Emission Levels

NOx (g/bhp-hr)	NOx (lbs/hr)	CO (g/bhp-hr)	CO (lbs/hr)	HCOH Dry (ppm)	HCOH@15% O2 (ppm)	HCOH (g/bhp-hr)	HCOH (lbs/hr)
1.87	4.86	0.06	0.15	7.54	3.53	0.036	0.094

APPENDIX B

Raw Calibration Data

BACKGROUND

Date	Time	NO 191C span	NO2 191C span	H2O% (high) 191C	Formaldehyde 191C	Ethylene 191C TE span	Propane 191C span	Acetaldehyde 191C span	CO ppm 191C (1of2) span	CO ppm Dry	CO2% 191C	NOx Wet	NOx Dry	NM NE HC C3
3/9/2016	8:35:03	0.445887	0.163718	0.001894	0.043709	1.067002	0.172473	-0.14471	0.25994	0.259944	-0.009404	0.80905	0.609616	5.462703
3/9/2016	8:35:10	0.014571	-0.062803	0.012873	0.135423	0.375369	1.842494	-1.73094	0.023243	0.023246	0.008972	-0.048232	-0.048238	4.731635
3/9/2016	8:35:17	0.269052	-0.030825	0.00151	-0.107772	0.52599	1.516535	-3.11671	-0.094457	-0.094458	0.001983	0.238226	0.238223	3.921306
3/9/2016	8:35:54	0	0	0	0	0	0	0	0	0	0	0	0	0
3/9/2016	8:36:03	-0.279448	-0.017113	0.011346	-0.051623	2.474753	-0.472945	-0.140843	-0.024252	-0.024523	-0.014449	-0.296561	-0.296561	3.385253
3/9/2016	8:36:15	-0.020491	0.141625	-0.000985	-0.274224	1.279336	1.001191	-1.507326	-0.344688	-0.344687	-0.017114	-0.138822	-0.138822	0.879385
3/9/2016	8:36:22	0.239411	0.00111	0.002364	0.001491	1.120449	-0.420234	-0.386997	-0.046774	-0.046375	-0.017575	0.319226	0.319226	0.000339
3/9/2016	8:36:30	0.288184	0.067323	0.000998	0.249184	1.269322	-0.424449	-0.296429	-0.386996	-0.386996	0.001254	0.353597	0.353597	0.024041903
3/9/2016	8:36:38	-0.121228	0.089077	0.012194	0.287573	0.995013	-0.844151	-1.43205	0.153339	0.153338	-0.001994	-0.052151	-0.052151	0.087354
3/9/2016	8:36:45	0.185714	0.007445	0.001379	0.029813	0.828487	-0.707698	-1.49645	0.121219	0.112192	-0.001251	0.193164	0.193167	0.007847
3/9/2016	8:36:52	0.197857	0.030221	0.003076	-0.102955	1.287132	-0.449307	-1.471715	0.071785	0.071785	-0.000901	0.228066	0.228073	0.181342
3/9/2016	8:37:00	-0.151805	0.015791	-0.001561	0.1297	0.125493	-0.103795	-0.850148	-0.3686519	-0.3686513	0.001823	-0.138011	0.138011	0.003527
3/9/2016	8:37:07	0.144369	0.036427	0.008679	-0.040713	-0.542577	-0.194128	-3.021979	-0.030721	-0.030723	-0.006859	0.180796	0.180811	0.124310

PRE DIRECT CAL

Date	Time	CO ppm 191C (1of2) span	NOx Wet	Propane 191C span	Date	Time	Ethylene 191C TE	Date	Time	Acetaldehyde 191C span
3/9/2016	8:37:15	8.471791	6.346896	5.404442	3/9/2016	8:44:13	32.892787	3/9/2016	8:41:11	14.730801
3/9/2016	8:37:22	250.020861	251.138943	232.103997	3/9/2016	8:44:20	180.804042	3/9/2016	8:41:18	31.087402
3/9/2016	8:37:30	468.379098	450.797138	447.098878	3/9/2016	8:44:28	102.924144	3/9/2016	8:41:26	31.543266
3/9/2016	8:37:37	495.322843	490.828785	481.317817	3/9/2016	8:44:35	100.096287	3/9/2016	8:41:33	31.543266
3/9/2016	8:37:45	501.728336	497.044494	484.815882	3/9/2016	8:44:43	101.682141	3/9/2016	8:41:41	30.56341
3/9/2016	8:37:52	502.655672	499.321519	496.281996	3/9/2016	8:44:50	103.800312	3/9/2016	8:41:48	32.424705
3/9/2016	8:38:00	505.436631	499.798848	493.204128	3/9/2016	8:44:58	103.635669	3/9/2016	8:41:56	31.874668
3/9/2016	8:38:07	504.124037	499.286782	495.342039	3/9/2016	8:45:05	103.014205	3/9/2016	8:42:03	31.511812
3/9/2016	8:38:15	504.842378	498.818143	493.774034	3/9/2016	8:45:13	102.120381			
3/9/2016	8:38:22	503.92409	498.905348	490.030848	3/9/2016	8:45:20	101.746376			
3/9/2016	8:38:30	506.077741	499.526621	494.176191						

NO2 CAL

Date	Time	NO2 191C span
3/9/2016	8:42:42	103.879064
3/9/2016	8:42:49	135.188715
3/9/2016	8:42:57	138.699564
3/9/2016	8:43:04	139.551399
3/9/2016	8:43:12	139.674118
3/9/2016	8:43:19	140.151325
3/9/2016	8:43:27	140.392538
3/9/2016	8:43:34	140.737785
3/9/2016	8:43:42	141.265061
3/9/2016	8:43:49	142.631966

PRE SYSTEM CAL

Date	Time	CO ppm 191C (1of2) span	NOx Wet	Propane 191C span	Date	Time	Ethylene 191C TE	Date	Time	Acetaldehyde 191C span
3/9/2016	8:45:49	19.79866	202.892218	5.521816	3/9/2016	8:49:06	32.894918	3/9/2016	8:47:22	3.728196
3/9/2016	8:45:57	157.462543	236.4623	126.312389	3/9/2016	8:49:13	100.627032	3/9/2016	8:47:30	27.332245
3/9/2016	8:46:04	444.603614	438.782696	433.407926	3/9/2016	8:49:21	104.444088	3/9/2016	8:47:37	30.977738
3/9/2016	8:46:12	458.911716	453.595839	452.392346	3/9/2016	8:49:28	102.712592	3/9/2016	8:47:45	30.115461
3/9/2016	8:46:19	487.709645	460.008371	458.052279	3/9/2016	8:49:36	103.281407	3/9/2016	8:47:52	30.105721
3/9/2016	8:46:27	471.96211	484.40466	464.403324	3/9/2016	8:49:43	103.61069	3/9/2016	8:48:00	29.900047
3/9/2016	8:46:34	479.688302	473.537016	468.642439	3/9/2016	8:49:51	102.851285	3/9/2016	8:48:07	30.191335
3/9/2016	8:46:41	486.369641	479.700416	477.7284	3/9/2016	8:49:58	104.172783	3/9/2016	8:48:15	31.113369
3/9/2016	8:46:48	491.608682	484.193716	476.517383	3/9/2016	8:50:06	102.497762	3/9/2016	8:48:22	30.873627
3/9/2016	8:46:56	494.798309	490.176637	486.370651	3/9/2016	8:50:13	104.128161			

SAMPLE SPIKE RECOVERY

Date	Time	CO2% 191C	CO ppm 191C (1of2) span	NO 191C span	Propane 191C span
3/9/2016	8:56:33	6.691565	11.154126	184.738217	5.3044
3/9/2016	8:56:41	6.702092	11.154199	200.385768	4.961454
3/9/2016	8:56:48	6.724988	11.47322	204.406541	6.474009
3/9/2016	8:56:59	6.724988	11.210318	203.209534	4.834968
3/9/2016	8:57:03	6.628893	10.885718	181.419487	6.608745
3/9/2016	8:57:33	6.653912	10.984622	195.734083	5.328183
3/9/2016	8:57:41	6.682775	11.00339	197.542028	6.665398
3/9/2016	8:57:48	4.219988	7.427854	118.769973	4.48612
3/9/2016	8:57:56	0.865118	127.310054	159.11534	117.844849
3/9/2016	8:58:03	5.4989519	86.986088	238.746998	80.462333
3/9/2016	8:58:11	5.985098	61.693251	223.17805	54.520651
3/9/2016	8:58:33	6.017444	60.205375	223.735545	53.47318
3/9/2016	8:58:40	6.027144	60.803724	229.427589	54.655565
3/9/2016	8:58:46	6.00938	60.220141	227.032303	53.363375
3/9/2016	8:58:56	6.000772	80.220034	223.381818	54.2957
3/9/2016	8:59:03	5.972768	59.854071	224.66405	53.420038
3/9/2016	8:59:10	5.968955	59.529548	228.195207	54.367049
3/9/2016	8:59:18	5.978786	80.284794	221.806906	54.87452
3/9/2016	8:59:25	6.007781	60.073978	224.165974	54.104399
3/9/2016	8:59:33	5.999851	59.902406	227.250182	53.719523
3/9/2016	8:59:40	5.999729	59.771773	226.303372	53.978595

ACETALDEHYDE SPIKE RECOVERY

Date	Time	CO2% 191C	Acetaldehyde 191C span
3/9/2016	8:52:38	2.520468	-0.27854
3/9/2016	8:52:47	2.467288	-0.19088
3/9/2016	8:52:54	2.486632	-1.15772
3/9/2016	8:51:02	2.474783	-0.14342
3/9/2016	8:51:09	2.479665	-0.97874
3/9/2016	8:51:16	2.469323	-1.02284
3/9/2016	8:51:24	2.478104	-0.841508
3/9/2016	8:51:32	2.463866	0.233519
3/9/2016	8:51:39	2.447283	-0.4789
3/9/2016	8:51:46	2.449907	-0.402805
3/9/2016	8:51:54	2.444167	0.800805
3/9/2016	8:52:02	5.797159	-1.018659
3/9/2016	8:52:09	0.85	0.910775
3/9/2016	8:52:16	8.69377	-0.380821
3/9/2016	8:52:24	6.792034	-0.715518
3/9/2016	8:52:54	6.701325	-0.940429
3/9/2016	8:53:01	6.697222	-0.452213
3/9/2016	8:53:09	4.686838	0.099394
3/9/2016	8:53:16	0.329794	22.227717
3/9/2016	8:53:24	5.041388	8.105944
3/9/2016	8:53:31	6.021688	2.465545
3/9/2016	8:53:39	6.017945	2.447049
3/9/2016	8:53:46	6.041282	2.578493
3/9/2016	8:53:54	6.075248	1.999131
3/9/2016	8:54:01	6.179368	1.890038
3/9/2016	8:54:09	6.291812	1.040429
3/9/2016	8:54:16	6.329081	1.094547
3/9/2016	8:54:24	6.318873	1.087773
3/9/2016	8:54:31	6.222675	1.953594
3/9/2016	8:54:39	6.169974	2.490019
3/9/2016	8:54:45	6.112977	1.773757
3/9/2016	8:55:01	6.127477	1.94459
3/9/2016	8:55:09	6.092376	2.772601
3/9/2016	8:55:16	6.128741	2.847158
3/9/2016	8:55:24	6.11691	2.300388
3/9/2016	8:55:31	6.153638	2.885438
3/9/2016	8:55:39	6.160697	2.581089
3/9/2016	8:55:46	6.137188	2.814542
3/9/2016	8:55:53	6.140921	2.897509
3/9/2016	8:56:01	6.138499	2.032712
3/9/2016	8:56:08	6.067241	1.796107

POST DIRECT CAL

Date	Time	CO ppm 191C (1of2) span	NOx Wet	Propane 191C span	Date	Time	Ethylene 191C TE	Date	Time	Acetaldehyde 191C span
3/9/2016	12:28:25	431.337146	447.58404	429.305328	3/9/2016	12:28:50	95.115312	3/9/2016	12:33:58	2.387599
3/9/2016	12:28:32	475.542714	489.879286	465.421671	3/9/2016	12:28:57	103.493158	3/9/2016	12:34:05	0.681923
3/9/2016	12:28:40	490.164879	487.591688	477.839718	3/9/2016	12:27:05	103.259872	3/9/2016	12:34:13	1.934911
3/9/2016	12:28:47	495.735453	493.104819	490.467557	3/9/2016	12:27:12	103.110765	3/9/2016	12:34:20	24.833385
3/9/2016	12:28:55	497.343681	495.592804	493.129439	3/9/2016	12:27:20	104.490198	3/9/2016	12:34:28	31.142783
3/9/2016	12:29:02	499.13497	495.094556	495.558417	3/9/2016	12:27:27	102.917035	3/9/2016	12:34:35	31.747437
3/9/2016	12:29:10	497.82526	495.62868	498.930494	3/9/2016	12:27:35	102.954241	3/9/2016	12:34:43	31.11643
3/9/2016	12:29:17	497.305355	495.754281	497.323981	3/9/2016	12:27:42	102.953001	3/9/2016	12:34:50	31.889782
3/9/2016	12:29:25	498.854917	495.578497	494.599213	3/9/2016	12:27:50	101.823078	3/9/2016	12:34:58	32.094955
3/9/2016	12:29:32	497.101716	495.466984	495.304376	3/9/2016	12:27:57	103.103108	3/9/2016	12:35:05	31.567802

FTIR QA/QC SUMMARY

SAMPLE RECOVERY CALCULATIONS																
Period	Spike #	Concentration of CO Cylinder	Concentration of Propane Cylinder	Concentration of NO Cylinder	Stack CO2 Concentration	Stack CO Concentration	Stack NO Concentration	Stack Propane Concentration	Stack + Spike CO2 Concentration	Stack + CO Concentration	Stack + NO Concentration	Stack + Propane Concentration	DF Calculated	% Recovery CO	% Recovery NO	% Recovery Propane
PRE TEST	1	504.0	498.0	500.3	6.7	11.0	194.9	6.3	6.0	60.3	224.9	54.1	0.100	100.0%	98.8%	97.2%

ACETALDEHYDE SAMPLE RECOVERY CALCULATIONS								
Period	Spike #	Concentration of CH3CHO Cylinder	Stack CO2 Concentration	Stack CH3CHO Concentration	Stack + Spike CO2 Concentration	DF Calculated	% Recovery CH3CHO	
PRE TEST	1	30.2	6.8	-0.4	6.1	2.5	0.095	98.3%

PRE SYSTEM CAL				
Sensor	System Response (ppm)	Cal Level (ppm)	Cal Recovery (%)	
NOx	490.2	500.3	-2.02	
CO	494.8	504.0	-1.83	
Propane	487.0	498.0	-2.21	
Ethylene*	104.1	102.4	1.69	
Acetaldehyde	30.9	30.2	2.16	

PRE DIRECT CAL					
Sensor	Analyzer Response (ppm)	Cal Level (ppm)	Zero Response (ppm)	Cal Error (%)	Zero Error (%)
NOx	499.5	500.3	0.4	-0.15	0.08
CO	505.1	504.0	-0.1	0.21	-0.01
Propane	494.2	498.0	0.4	-0.77	0.08
Ethylene	101.7	102.4	-0.4	-0.64	-0.40
Acetaldehyde	31.5	30.2	-0.4	4.27	-1.36

POST DIRECT CAL					
Sensor	Analyzer Response (ppm)	Cal Level (ppm)	Zero Response (ppm)	Cal Error (%)	Zero Error (%)
NOx	495.5	500.3	0.3	-0.97	0.06
CO	497.1	504.0	0.1	-1.37	0.02
Propane	496.3	498.0	0.4	-0.34	0.08
Ethylene	103.1	102.4	-0.4	0.69	-0.40
Acetaldehyde	31.6	30.2	0.4	4.46	1.35

*CTS Scans are conducted with Ethylene through the sample line

CERTIFICATE OF ANALYSIS
Grade of Product: EPA Protocol

Airgas Specialty Gases
12722 South Wentworth Avenue
Chicago, IL 60628
(773) 785-3000 Fax: (773) 785-1928
Airgas.com

Part Number: E05NI99E15A0000
Cylinder Number: SG9163466BAL
Laboratory: ASG - Chicago - IL
PGVP Number: B12015
Gas Code: CH4,CO,NO,NOX,PPN,BALN

Reference Number: 54-124493548-1
Cylinder Volume: 144.4 CF
Cylinder Pressure: 2015 PSIG
Valve Outlet: 660
Certification Date: May 20, 2015

Expiration Date: May 20, 2023

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a volume/volume basis unless otherwise noted.

Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	500.0 PPM	500.3 PPM	G1	+/- 0.6% NIST Traceable	05/13/2015, 05/20/2015
CARBON MONOXIDE	500.0 PPM	504.0 PPM	G1	+/- 1.0% NIST Traceable	05/13/2015
METHANE	500.0 PPM	499.9 PPM	G1	+/- 1.0% NIST Traceable	05/14/2015
NITRIC OXIDE	500.0 PPM	500.3 PPM	G1	+/- 0.6% NIST Traceable	05/13/2015, 05/20/2015
PROPANE	500.0 PPM	498.0 PPM	G1	+/- 1% NIST Traceable	05/15/2015
NITROGEN	Balance				

CALIBRATION STANDARDS

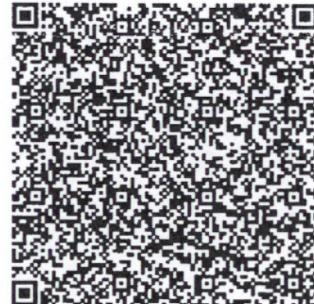
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	12062431	CC366888	487.1 PPM CARBON MONOXIDE/NITROGEN	+/- 0.6%	Jun 22, 2018
PRM	12312	680179	10.01 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.0%	Feb 14, 2012
NTRM	10060909	CC320616	500.5 PPM METHANE/NITROGEN	+/- 0.6%	Aug 07, 2016
NTRM	12061027	CC359428	500.7 PPM NITRIC OXIDE/NITROGEN	+/- 0.5%	Feb 16, 2018
GMIS	0207201402	CC500987	4.845 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.0%	Feb 07, 2017
NTRM	10060514	CC281296	495.3 PPM PROPANE/AIR	+/- 0.5%	Feb 19, 2016

The SRM, PRM or RGM noted above is only in reference to the GMIS used in the assay and not part of the analysis.

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nexus 470 AEP0000428	FTIR	Apr 16, 2015
Nicolet 6700 AHR0801332	FTIR	May 08, 2015
Nexus 470 AEP0000428	FTIR	May 16, 2015
Nexus 470 AEP0000428	FTIR	May 16, 2015
MKS Multigas 17707558	FTIR	May 08, 2015

Triad Data Available Upon Request



CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Airgas Specialty Gases

12722 South Wentworth Avenue
Chicago, IL 60628
(773) 785-3000 Fax: (773) 785-1928
Airgas.com

Part Number: E03NI99E15A2059
Cylinder Number: CC500474
Laboratory: ASG - Chicago - IL
PGVP Number: B12015
Gas Code: NO₂,O₂,BALN

Reference Number: 54-124488819-1
Cylinder Volume: 144.4 Cubic Feet
Cylinder Pressure: 2015 PSIG
Valve Outlet: 660
Certification Date: Apr 24, 2015

Expiration Date: Apr 24, 2018

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a volume/volume basis unless otherwise noted.

Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NITROGEN DIOXIDE	150.0 PPM	144.5 PPM	G1	+/- 2%	04/17/2015, 04/24/2015
NITROGEN	Balance				

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
GMIS	124415809101	CC501027	196.8 PPM NITROGEN DIOXIDE/NITROGEN	+/- 1.1%	Aug 20, 2017
PRM	12326	APEX1005712	250.4 PPM NITROGEN DIOXIDE/NITROGEN	+/- 1.0%	Jul 15, 2015

The SRM, PRM or RGM noted above is only in reference to the GMIS used in the assay and not part of the analysis.

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
MKS Multigas 17707558	FTIR	Apr 08, 2015

Triad Data Available Upon Request



CERTIFICATE OF ANALYSIS

Grade of Product: PRIMARY STANDARD

Part Number:	X02NI99P15AD524	Reference Number:	54-124520303-2
Cylinder Number:	CC192905	Cylinder Volume:	144.4 CF
Laboratory:	ASG - Chicago - IL	Cylinder Pressure:	2015 PSIG
Analysis Date:	Oct 28, 2015	Valve Outlet:	350
Lot Number:	54-124520303-2		

Primary Standard Gas Mixtures are traceable to N.I.S.T. weights and/or N.I.S.T. Gas Mixture reference materials.

ANALYTICAL RESULTS

Component	Req Conc	Actual Concentration (Mole %)	Analytical Uncertainty
ETHYLENE	100.0 PPM	102.4 PPM	+/- 1%
NITROGEN	Balance		



CERTIFICATE OF ANALYSIS

Grade of Product: CERTIFIED HYDROCARBON

Customer: *HENDERSON,, CO* - OASIS EMISSION
Part Number: X02NI99C80AC031
Cylinder Number: LL106285
Laboratory: ASG - LaPorte Mix (SAP) - TX
Analysis Date: Aug 14, 2015
Lot Number: 126-400584491-1

Reference Number: 126-400584491-1
Cylinder Volume: 75.2 CF
Cylinder Pressure: 2000 PSIG
Valve Outlet: 350SS
Expiration Date: Aug 14, 2016

Traceability Statement: Hydrocarbon Process standards are NIST traceable either directly by weight or by comparison to Airgas laboratory standards that are directly NIST traceable by weight.

CERTIFIED CONCENTRATIONS

Component	Requested Concentration	Reported Mole %	Accuracy
ACETALDEHYDE	30.00 PPM	30.22 PPM	+/- 5%
NITROGEN	Balance	Balance	

Notes:
PO # CODY

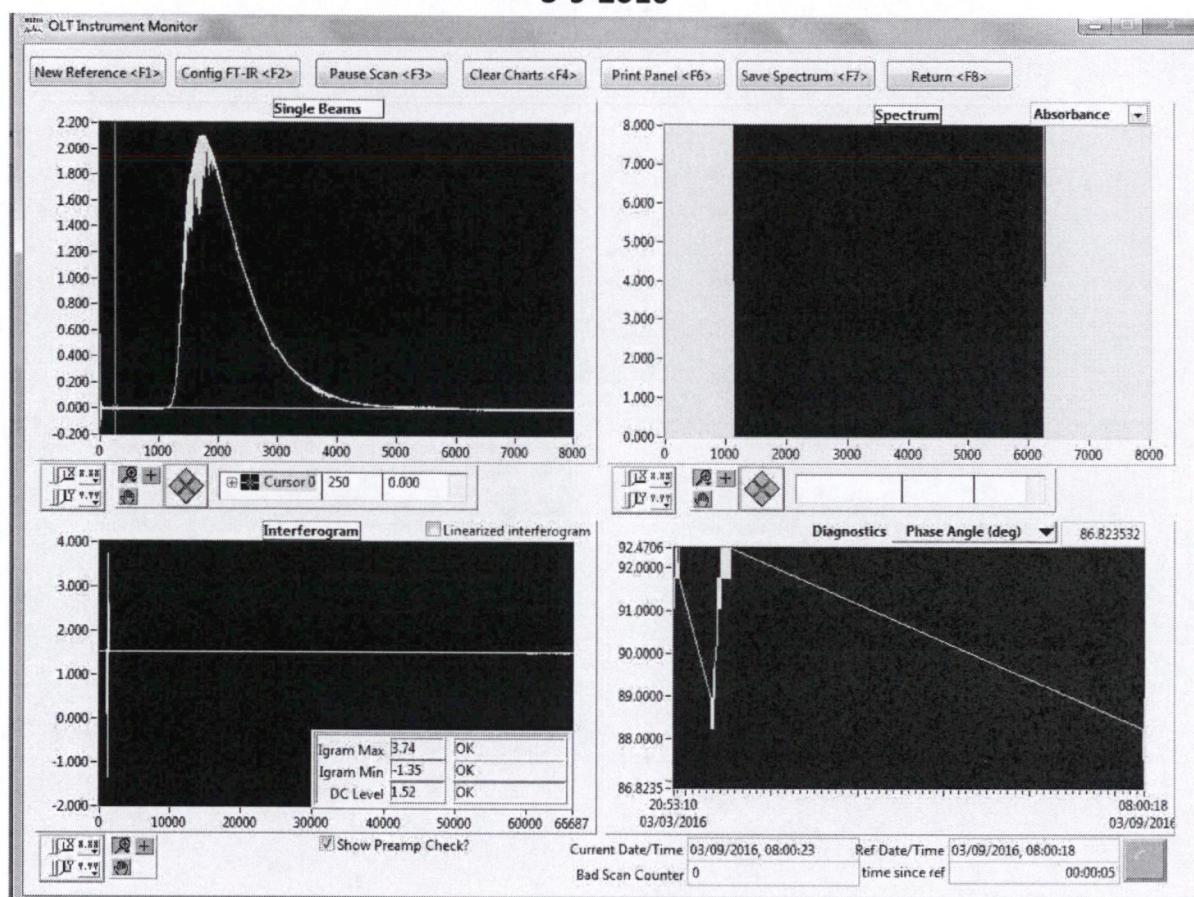


Signature on file

Approved for Release

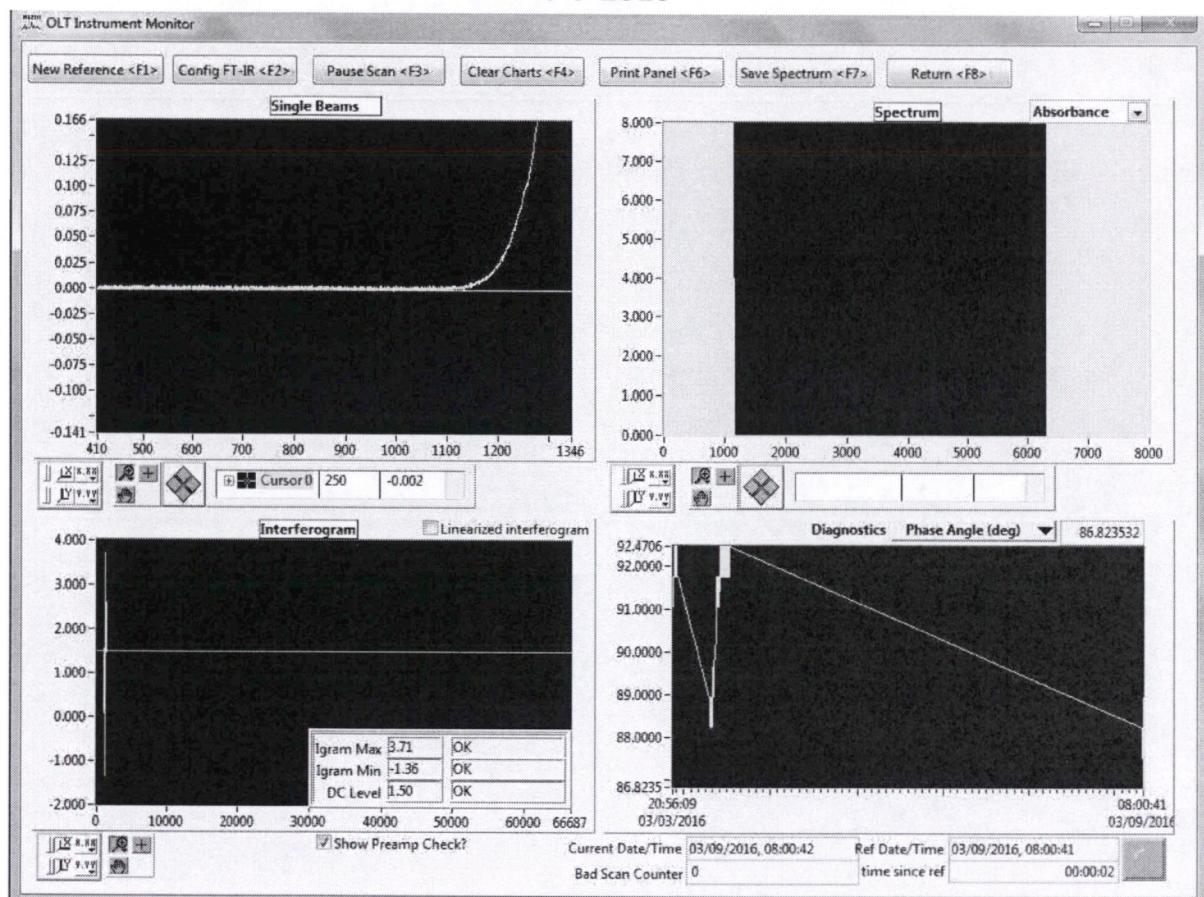
XTO - LCU #2

3-9-2016



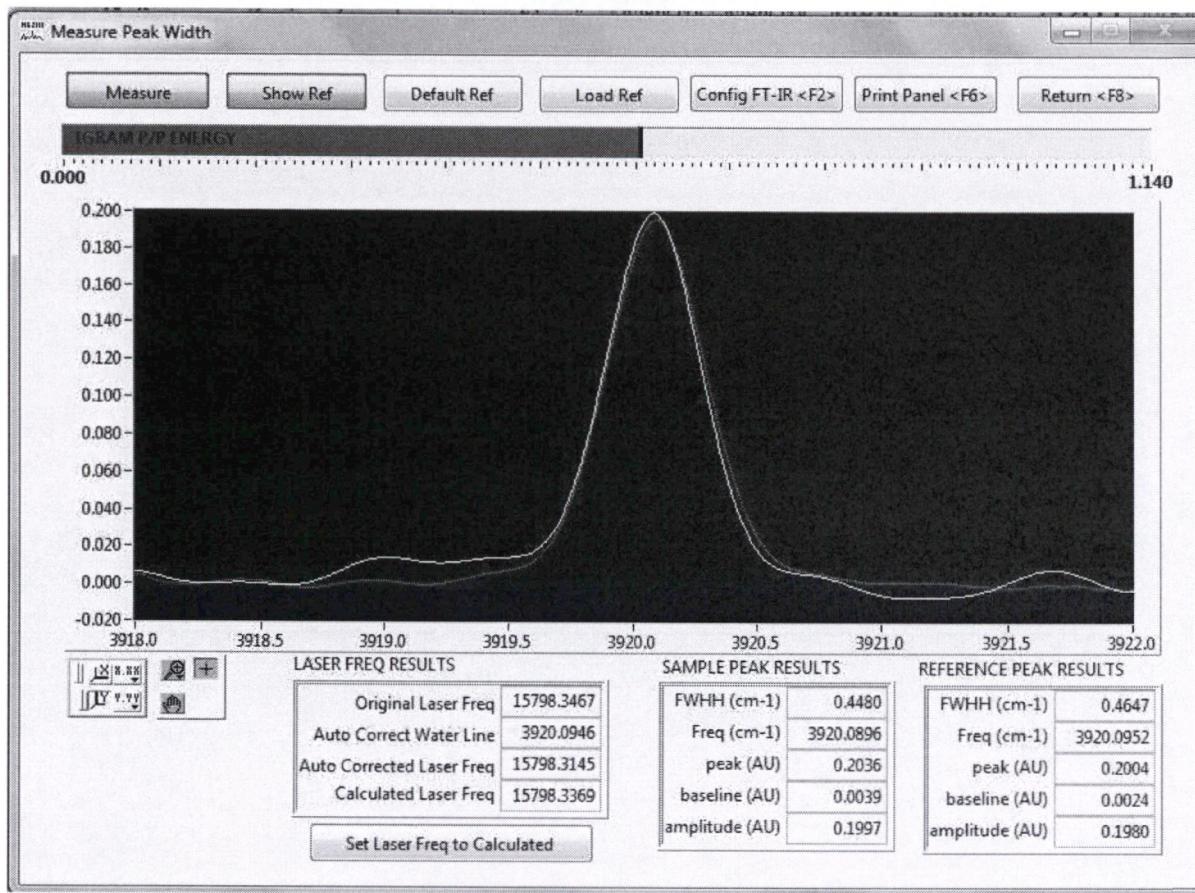
XTO – LCU #2

3-9-2016



XTO – LCU #2

3-9-2016



Instrument Resolution – FWHH – 0.4480 cm⁻¹ which is < 0.55 cm⁻¹ (therefore meets ASTM)

Water Frequency – Freq – 3920.0896 cm⁻¹ which is +/- 0.075 of 3920.0952 cm⁻¹ (therefore meets ASTM)

Please note: FWHH is the Full Width at Half Height of the resolution. The frequency position is only calculating the center line for one water line in the spectrum. MKS uses 3920.0952 cm⁻¹ since it is a single water line.

CO/NO/NO₂/Formaldehyde/Propane FTIR Instrument Noise-Limited Minimum Detectable Concentration - MDC#2

Noise Equivalent Absorbance Data					
Spectrum	CO	NO	NO ₂	Formaldehyde	Propane
XTO LITTLE CANYON CS LCU#2 3-9-16_000006.LAB	-0.34	-0.28	0.14	-0.27	1.08
XTO LITTLE CANYON CS LCU#2 3-9-16_000007.LAB	-0.05	0.24	0.08	0.02	-0.42
XTO LITTLE CANYON CS LCU#2 3-9-16_000008.LAB	-0.37	0.29	0.07	0.25	-0.42
XTO LITTLE CANYON CS LCU#2 3-9-16_000009.LAB	0.15	-0.12	0.07	0.30	-0.84
XTO LITTLE CANYON CS LCU#2 3-9-16_000010.LAB	0.11	0.19	0.01	0.03	-0.71
XTO LITTLE CANYON CS LCU#2 3-9-16_000011.LAB	0.07	0.20	0.03	-0.10	-0.45
XTO LITTLE CANYON CS LCU#2 3-9-16_000012.LAB	-0.37	-0.15	0.02	0.13	-0.10
XTO LITTLE CANYON CS LCU#2 3-9-16_000013.LAB	-0.03	0.14	0.04	-0.04	-0.19
Noise Equivalent Absorbance (Standard Deviation)	0.21	0.20	0.04	0.17	0.55
MDC #2	0.63	0.60	0.12	0.52	1.66

APPENDIX C

G3516

GAS ENGINE SITE SPECIFIC TECHNICAL DATA XTO - LCU #2

CATERPILLAR®

GAS COMPRESSION APPLICATION

ENGINE SPEED (rpm):	1357
COMPRESSION RATIO:	8
AFTERCoolER TYPE:	SCAC
AFTERCoolER WATER INLET (°F):	130
JACKET WATER OUTLET (°F):	210
ASPIRATION:	TA
COOLING SYSTEM:	JW+OC, AC
CONTROL SYSTEM:	ADEM3
EXHAUST MANIFOLD:	ASWC
COMBUSTION:	LOW EMISSION
NOx EMISSION LEVEL (g/bhp-hr NOx):	2.0
SET POINT TIMING:	27

RATING STRATEGY:	STANDARD
RATING LEVEL:	CONTINUOUS
FUEL SYSTEM:	HPG IMPCO
SITE CONDITIONS:	WITH AIR FUEL RATIO CONTROL
FUEL:	Field Gas
FUEL PRESSURE RANGE(psig):	35.0-40.0
FUEL METHANE NUMBER:	62.1
FUEL LHV (Btu/scf):	1027
ALTITUDE(ft):	5278
MAXIMUM INLET AIR TEMPERATURE(°F):	42
STANDARD RATED POWER:	1340 bhp@1400rpm

RATING	NOTES	LOAD	SITE RATING AT MAXIMUM INLET AIR TEMPERATURE			
			100%	100%	75%	52%
ENGINE POWER (WITHOUT FAN)	(1)	bhp °F	1299	1296	972	670
INLET AIR TEMPERATURE			41	42	42	42

ENGINE DATA						
FUEL CONSUMPTION (LHV)	(2)	Btu/bhp-hr	7701	7702	7930	8412
FUEL CONSUMPTION (HHV)	(2)	Btu/bhp-hr	8509	8511	8762	9295
AIR FLOW (@inlet air temp, 14.7 psia)	(WET)	f3/min	2580	2575	1941	1374
AIR FLOW	(WET)	lb/hr	12239	12215	9206	6518
FUEL FLOW (60°F, 14.7 psia)	(3)(4)	scfm	162	162	125	91
INLET MANIFOLD PRESSURE	(3)(4)	in Hg(abs)	68.9	68.8	54.2	39.7
EXHAUST TEMPERATURE - ENGINE OUTLET	(5)	°F	907	907	906	910
EXHAUST GAS FLOW (@engine outlet temp, 14.5 psia)	(WET)	f3/min	7600	7585	5721	4069
EXHAUST GAS MASS FLOW	(WET)	lb/hr	12720	12696	9577	6789

EMISSIONS DATA - ENGINE OUT						
NOx (as NO2)	(8)(9)	g/bhp-hr	2.00	2.00	2.00	2.00
CO	(8)(9)	g/bhp-hr	2.26	2.26	2.36	2.52
THC (mol. wt. of 15.84)	(8)(9)	g/bhp-hr	2.43	2.43	2.53	2.68
NMHC (mol. wt. of 15.84)	(8)(9)	g/bhp-hr	0.63	0.63	0.66	0.69
NMNEHC (VOCs) (mol. wt. of 15.84)	(8)(9)(10)	g/bhp-hr	0.42	0.42	0.44	0.47
HCHO (Formaldehyde)	(8)(9)	g/bhp-hr	0.22	0.22	0.22	0.23
CO2	(8)(9)	g/bhp-hr	507	507	516	540
EXHAUST OXYGEN	(8)(11)	% DRY	7.8	7.8	7.8	7.5

HEAT REJECTION						
HEAT REJ. TO JACKET WATER (JW)	(12)	Btu/min	42507	42461	35319	29333
HEAT REJ. TO ATMOSPHERE	(12)	Btu/min	5150	5143	4287	3488
HEAT REJ. TO LUBE OIL (OC)	(12)	Btu/min	6339	6333	5267	4375
HEAT REJ. TO AFTERCOOLER (AC)	(12)(13)	Btu/min	8757	8757	5532	2003

COOLING SYSTEM SIZING CRITERIA			
TOTAL JACKET WATER CIRCUIT (JW+OC)	(13)	Btu/min	54365
TOTAL AFTERCOOLER CIRCUIT (AC)	(13)(14)	Btu/min	9195

A cooling system safety factor of 0% has been added to the cooling system sizing criteria.

CONDITIONS AND DEFINITIONS
 Engine rating obtained and presented in accordance with ISO 3046/1, adjusted for fuel, site altitude and site inlet air temperature. 100% rating at maximum inlet air temperature is the maximum engine capability for the specified fuel at site altitude and maximum site inlet air temperature. Maximum rating is the maximum capability at the specified aftercooler inlet temperature for the specified fuel at site altitude and reduced inlet air temperature. Lowest load point is the lowest continuous duty operating load allowed. No overload permitted at rating shown.

For notes information consult page three.

Run 1 - intake man press -> 30.9 psi -> 62.91 in Hg
 Pabs = 62.91 in Hg

by linear interpolation, est BHP => 1165.3 BHP

G3516

GAS ENGINE SITE SPECIFIC TECHNICAL DATA XTO - LCU #2

CATERPILLAR®

GAS COMPRESSION APPLICATION

ENGINE SPEED (rpm):	1366	RATING STRATEGY:	STANDARD
COMPRESSION RATIO:	8	RATING LEVEL:	CONTINUOUS
AFTERCoolER TYPE:	SCAC	FUEL SYSTEM:	HPG IMPCO
AFTERCoolER WATER INLET (°F):	130		WITH AIR FUEL RATIO CONTROL
JACKET WATER OUTLET (°F):	210		
ASPIRATION:	TA		
COOLING SYSTEM:	JW+OC, AC	FUEL:	Field Gas
CONTROL SYSTEM:	ADEM3	FUEL PRESSURE RANGE(psig):	35.0-40.0
EXHAUST MANIFOLD:	ASWC	FUEL METHANE NUMBER:	62.1
COMBUSTION:	LOW EMISSION	FUEL LHV (Btu/scf):	1027
NOx EMISSION LEVEL (g/bhp-hr NOx):	2.0	ALTITUDE(ft):	5278
SET POINT TIMING:	27	MAXIMUM INLET AIR TEMPERATURE(°F):	44
		STANDARD RATED POWER:	1340 bhp@1400rpm

RATING	NOTES	LOAD	100%	100%	75%	52%
ENGINE POWER INLET AIR TEMPERATURE (WITHOUT FAN)	(1)	bhp °F	1307 42	1297 44	973 44	670 44

ENGINE DATA						
FUEL CONSUMPTION (LHV)	(2)	Btu/bhp-hr	7705	7712	7944	8434
FUEL CONSUMPTION (HHV)	(2)	Btu/bhp-hr	8514	8521	8778	9319
AIR FLOW (@inlet air temp, 14.7 psia)	(WET)	f13/min	2599	2592	1954	1383
AIR FLOW	(WET)	lb/hr	12335	12245	9233	6536
FUEL FLOW (60°F, 14.7 psia)	(3)(4)	scfm	163	162	125	92
INLET MANIFOLD PRESSURE	(3)(4)	in Hg(abs)	69.2	68.7	54.1	39.6
EXHAUST TEMPERATURE - ENGINE OUTLET	(5)	°F	907	907	906	910
EXHAUST GAS FLOW (@engine outlet temp, 14.5 psia)	(WET)	f13/min	7660	7604	5739	4082
EXHAUST GAS MASS FLOW	(WET)	lb/hr	12820	12727	9605	6809

EMISSIONS DATA - ENGINE OUT						
NOx (as NO2)	(8)(9)	g/bhp-hr	2.00	2.00	2.00	2.00
CO	(8)(9)	g/bhp-hr	2.27	2.27	2.38	2.54
THC (mol. wt. of 15.84)	(8)(9)	g/bhp-hr	2.43	2.43	2.54	2.69
NMHC (mol. wt. of 15.84)	(8)(9)	g/bhp-hr	0.63	0.63	0.66	0.70
NMNEHC (VOCs) (mol. wt. of 15.84)	(8)(9)(10)	g/bhp-hr	0.42	0.42	0.44	0.47
HCHO (Formaldehyde)	(8)(9)	g/bhp-hr	0.22	0.22	0.22	0.24
CO2	(8)(9)	g/bhp-hr	508	508	517	541
EXHAUST OXYGEN	(8)(11)	% DRY	7.8	7.8	7.7	7.5

HEAT REJECTION						
HEAT REJ. TO JACKET WATER (JW)	(12)	Btu/min	42743	42568	35460	29447
HEAT REJ. TO ATMOSPHERE	(12)	Btu/min	5184	5158	4301	3500
HEAT REJ. TO LUBE OIL (OC)	(12)	Btu/min	6375	6349	5288	4392
HEAT REJ. TO AFTERCOOLER (AC)	(12)(13)	Btu/min	8903	8903	5570	2024

COOLING SYSTEM SIZING CRITERIA						
TOTAL JACKET WATER CIRCUIT (JW+OC)	(13)	Btu/min	54667			
TOTAL AFTERCOOLER CIRCUIT (AC)	(13)(14)	Btu/min	9348			

A cooling system safety factor of 0% has been added to the cooling system sizing criteria.

CONDITIONS AND DEFINITIONS

Engine rating obtained and presented in accordance with ISO 3046/1, adjusted for fuel, site altitude and site inlet air temperature. 100% rating at maximum inlet air temperature is the maximum engine capability for the specified fuel at site altitude and maximum site inlet air temperature. Maximum rating is the maximum capability at the specified aftercooler inlet temperature for the specified fuel at site altitude and reduced inlet air temperature. Lowest load point is the lowest continuous duty operating load allowed. No overload permitted at rating shown.

For notes information consult page three.

Run 2 - intake man press -> 31.3 psi -> 63.73 in Hg

Pabs = 63.73 in Hg

by linear interpolation, est BHP => 1186.7 BHP

G3516

GAS ENGINE SITE SPECIFIC TECHNICAL DATA XTO - LCU #2

CATERPILLAR®

GAS COMPRESSION APPLICATION

ENGINE SPEED (rpm):	1361
COMPRESSION RATIO:	8
AFTERCoolER TYPE:	SCAC
AFTERCoolER WATER INLET (°F):	130
JACKET WATER OUTLET (°F):	210
ASPIRATION:	TA
COOLING SYSTEM:	JW+OC, AC
CONTROL SYSTEM:	ADEM3
EXHAUST MANIFOLD:	ASWC
COMBUSTION:	LOW EMISSION
NOx EMISSION LEVEL (g/bhp-hr NOx):	2.0
SET POINT TIMING:	27

RATING STRATEGY:	STANDARD
RATING LEVEL:	CONTINUOUS
FUEL SYSTEM:	HPG IMPCO
	WITH AIR FUEL RATIO CONTROL
SITE CONDITIONS:	
FUEL:	Field Gas
FUEL PRESSURE RANGE(psig):	35.0-40.0
FUEL METHANE NUMBER:	62.1
FUEL LHV (Btu/scf):	1027
ALTITUDE(ft):	5278
MAXIMUM INLET AIR TEMPERATURE(°F):	45
STANDARD RATED POWER:	1340 bhp@1400rpm

RATING	(WITHOUT FAN)	NOTES	LOAD	MAXIMUM SITE RATING AT MAXIMUM INLET AIR TEMPERATURE			
				100%	100%	75%	52%
ENGINE POWER INLET AIR TEMPERATURE		(1)	bhp °F	1302 42	1283 45	970 45	670 45

ENGINE DATA							
FUEL CONSUMPTION (LHV)		(2)	Btu/bhp-hr	7703	7709	7940	8422
FUEL CONSUMPTION (HHV)		(2)	Btu/bhp-hr	8511	8518	8773	9306
AIR FLOW (@inlet air temp, 14.7 psia)	(WET)	(3)(4)	ft3/min	2589	2587	1950	1384
AIR FLOW	(WET)	(3)(4)	lb/hr	12282	12198	9195	6526
FUEL FLOW (60°F, 14.7 psia)			scfm	163	162	125	92
INLET MANIFOLD PRESSURE		(5)	in Hg(abs)	69.0	68.6	54.0	39.6
EXHAUST TEMPERATURE - ENGINE OUTLET		(6)	°F	907	907	906	910
EXHAUST GAS FLOW (@engine outlet temp, 14.5 psia)	(WET)	(7)(4)	ft3/min	7627	7574	5715	4075
EXHAUST GAS MASS FLOW	(WET)	(7)(4)	lb/hr	12765	12678	9566	6798

EMISSIONS DATA - ENGINE OUT							
NOx (as NO2)		(8)(9)	g/bhp-hr	2.00	2.00	2.00	2.00
CO		(8)(9)	g/bhp-hr	2.26	2.27	2.37	2.52
THC (mol. wt. of 15.84)		(8)(9)	g/bhp-hr	2.43	2.43	2.54	2.68
NMHC (mol. wt. of 15.84)		(8)(9)	g/bhp-hr	0.63	0.63	0.66	0.70
NMNEHC (VOCs) (mol. wt. of 15.84)		(8)(9)(10)	g/bhp-hr	0.42	0.42	0.44	0.47
HCHO (Formaldehyde)		(8)(9)	g/bhp-hr	0.22	0.22	0.22	0.24
CO2		(8)(9)	g/bhp-hr	508	508	517	541
EXHAUST OXYGEN		(8)(11)	% DRY	7.8	7.8	7.7	7.5

HEAT REJECTION							
HEAT REJ. TO JACKET WATER (JW)		(12)	Btu/min	42612	42449	35354	29384
HEAT REJ. TO ATMOSPHERE		(12)	Btu/min	5165	5141	4287	3494
HEAT REJ. TO LUBE OIL (OC)		(12)	Btu/min	6355	6331	5273	4382
HEAT REJ. TO AFTERCOOLER (AC)		(12)(13)	Btu/min	8822	8822	5513	2013

COOLING SYSTEM SIZING CRITERIA							
TOTAL JACKET WATER CIRCUIT (JW+OC)			(13)	Btu/min	54499		
TOTAL AFTERCOOLER CIRCUIT (AC)			(13)(14)	Btu/min	9263		

A cooling system safety factor of 0% has been added to the cooling system sizing criteria.

CONDITIONS AND DEFINITIONS

Engine rating obtained and presented in accordance with ISO 3046/1, adjusted for fuel, site altitude and site inlet air temperature. 100% rating at maximum inlet air temperature is the maximum engine capability for the specified fuel at site altitude and maximum site inlet air temperature. Maximum rating is the maximum capability at the specified aftercooler inlet temperature for the specified fuel at site altitude and reduced inlet air temperature. Lowest load point is the lowest continuous duty operating load allowed. No overload permitted at rating shown.

For notes information consult page three.

Run 3 - intake man press -> 31.2 psi -> 63.52 in Hg

Pabs = 63.52 in Hg

by linear interpolation, est BHP => 1180.6 BHP

APPENDIX D

EPA Method 19 Calculations

Test Run	Fd Factor	BSFC	Approx. BHP	Avg O2 %	NOx ppmvd	NOx g/bhp-hr	NOx lbs/hr	CO ppmvd	CO g/bhp-hr	CO lbs/hr	HCOH ppmvd	HCOH g/bhp-hr	HCOH lbs/hr	Moisture Content %
1	8710	9400	1165.3	8.1	258.06	1.86	4.78	12.42	0.05	0.14	7.91	0.037	0.096	12.19
2	8710	9400	1186.7	8.3	252.04	1.85	4.83	12.41	0.06	0.15	7.65	0.037	0.096	11.61
3	8710	9400	1180.6	8.3	254.77	1.87	4.86	12.45	0.06	0.15	7.54	0.036	0.094	11.49
Average Levels			1177.5	8.2	254.96	1.86	4.83	12.43	0.06	0.14	7.70	0.037	0.096	11.76

APPENDIX E

FTIR Engine Test Sheet

Company Name	XTO
Location / Unit I.D.	Little Canyon CS LCU#2
Type of Test Completed:	FTIR 3x1hr N.C.H
Field Technician (s)	Kevin Watkins
Client Rep and/or State Rep	Derrick (XTO)
Date:	3-9-16

	Test 1	Test 2	Test 3
Time of Readings	9:15 AM	10:19 AM	11:25 AM
Atm Pressure (in Hg)	24.62	24.63	24.63
Atm Temp (°F)	42°	44°	45°
Engine RPM	1357	1366	1361
*Manifold Pres. Vac(") or Boost(psi)	30.9	31.3	31.2
Manifold Temp (°F)	131°	134°	138.2
Psuction (psi) Stage 1	31	32	32
Tsuction (°F) Stage 1	44°	46°	48°
Pdischarge (psi) Stage 1	146	139	139
Psuction (psi) Stage 2	146	139	139
Tsuction (°F) Stage 2			
Pdischarge (psi) Stage 2	433	432	430
Psuction (psi) Stage 3			
Tsuction (°F) Stage 3			
Pdischarge (psi) Stage 3			
Psuction (psi) Stage 4			
Tsuction (°F) Stage 4			
Pdischarge (psi) Stage 4			
Gas Throughput (mmcf/d)	6.7	6.7	6.7
Pre CO (ppm)			
Pre Cat Temp (°F)	851°	856°	852°
Post Cat Temp (°F)			
Cat Differential Pres. (" of H2O)	2.9"	2.9"	2.9"
Impinger 1 (grams)	/	/	/
Impinger 2 (grams)	/	/	/
Impinger 3 (grams)	/	/	/
Impinger 4 (grams)	/	/	/
Dry Gas Meter (cubic ft)	/	/	/
DGM Inlet Temp (deg F)	/	/	/
DGM Outlet Temp (deg F)	/	/	/
O2 %	8.1%	8.3%	8.3%
CO2 %	Dry 7.4%	7.3%	4.4%
LOAD %	Calculated by Mechanic 95%	95%	95%
Delta H			
Ignition Timing (°F)	25.3°	25.4°	25.2°
AFR Setting mV (Left Bank)			
AFR Setting mV (Right Bank)			
Upstream Port Distance (pd)			
Downstream Port Distance (pd)			
Exhaust Diameter (inches)	12"	Cylinder Serial #↓	
Propane	498		
NO	500.3		
CO	504		
NO2	144.5		
Ethylene	102.4		
Methane	499.7		
Acetaldehyde			
Engine Make	CAT		
Engine Model	35L6LE		
Engine S/N	4EK04246		

* Some units show boost in inches of Hg. In this situation please indicate if it is positive (+) or negative (-). Eg: (+12") or (-5")

Rev 5

5/25/2011

Max Load As Per Mechanic

X10 Little -
12" Stack
3-9-16

Worksheet: O2 Stratification

Port	Point	Insertion Depth (inches)	Reading (%)
A	1	0.5	8.2
A	2	0.8	8.2
A	3	1.42	8.1
A	4	2.12	8.1
A	5	3	8.1
A	6	4.27	8.1
A	7	7.73	8.1
A	8	9	8.1
A	9	9.88	8.1
A	10	10.58	8.1
A	11	11.2	8.1
A	12	11.5	8.1
Average			8.1

Notes: To demonstrate non-stratified flow and utilize one sampling location
O2 may not deviate by more than +/- 0.3%.